DOCUMENT RESUME

ED 310 789 IR 052 865

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TITLE A Comparison of Computer-Based Bibliographic Database Searching vs. Manual Bibliographic Searching. Final CARE Grant Report #5964.
PUB DATE 86
NOTE 9p.
PUB TYPE Reports - Research/Technical (143)

EDRS PRICE MF01/PC01 Plus Postage.
DESCRIPTORS Academic Libraries; *Bibliographic Databases; Comparative Analysis; *Cost Effectiveness; *Indexes; *Information Retrieval; *Online Systems; Search Strategies; User Needs (Information); *User Satisfaction (Information)

ABSTRACT

The purpose of this study was to improve upon previous research investigations by analyzing the elements of cost effectiveness, precision, recall, citation overlap, and hours searching in a comparison between computerized database searching and manual searching, using the setting of an academic library environment with a diverse group of students as subjects. Students enrolled in Library 301 (computer searching) during four academic quarters in 1985 and 1986 at two California colleges provided the laboratory sample for the data collection (N=64). The students were introduced to three weeks of instruction on the concepts of manual search searching and three weeks on automated search techniques and strategies. The remaining four weeks were spent applying the knowledge to a research project that required using both types of search skills. The results indicated that: (1) contrary to previous studies, in most cases online searching was not a cost-effective method for retrieving data; (2) higher recall occurred online, while higher precision occurred through manual searching; (3) the citation overlap between the two sources was 2.9%; and (4) more time was spent searching manually than online. Areas identified for further research include the relationship between satisfaction and precision (high satisfaction is not synonymous with high precision); the influence of multiple instrumental strategies on search output; and the relationship between the number of relevant items found and the time expended. Data are compiled in seven tables and a 16-item bibliography is provided. (SD)

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A COMPARISON OF COMPUTER-BASED BIBLIOGRAPHIC DATABASE SEARCHING VS MANUAL BIBLIOGRAPHIC SEARCHING

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Robert E. Kennedy Library

Final CARE Grant Report #5964

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OBJECTIVES OF THE STUDY

The purpose of this study was to improve upon previous research investigations by analyzing the elements of cost effectiveness, precision, recall, citation overlap, and hours searching in a comparison between computerized database searching and manual searching, using the setting of an academic library environment with a diverse group of students as subjects.

SUMMARY OF ACTIVITY

During the Winter 1985, Spring 1985, Winter 1986, and Spring 1986 quarters, students who enrolled in Library 301 (Computer Searching) provided the laboratory sample for the initial data collection (N=64).

The students were systematically introduced to three weeks of instruction on the concepts of manual search techniques and strategies, and three weeks of instruction on automated search techniques and strategies. The remaining four weeks were spent directly applying this knowledge to the completion of a literature search project under the supervision of a subject-specialist librarian. The project required the students to use both manual and online search skills. Principles stressed in the course included information organization; retrievable access points; use of thesauri and controlled vocabulary authority listings; tactics and strategies for shaping a search inquiry; and applications of research problems to multidisciplinary sources. All participants were responsible for completing both a manual and an online search experience on an identical topic, a research strategy log, several search strategy worksheets, and a project questionnaire.

The searches were evaluated by the principle investigators of the study according to the performance measures of cost effectiveness, precision, recall, citation overlap, and time expended.

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PROJECT RESULTS

a. Cost Effectiveness

Flynn (1979) indicates that online bibliographic literature retrieval is considerably more cost-effective than traditional library manual searching, while East (1980) states that a review of published studies reveals that the cost of comparable manual and on-line searches are approximately equal. Since there are conflicting opinions in the literature on this topic, it was deemed an important variable to include in this study.

Our results contrast with Flynn. Using the formula

$$\frac{(Cm-Co)}{Co} \quad X \quad 100$$

in which cost effectiveness is determined by subtracting online search costs (actual charges) from manual search costs (estimated at $5/hr) and expressing the difference as a percentage of online costs, our study showed that, in most cases, computer searching was not a cost effective method for retrieving data (see Table 1). This may be due, in part, to the fact that students (on the average) spent more hours searching manually for information than they spent time on online searching activities.

It should be pointed out, however, that Flynn based his calculations on estimated average time spent on each activity from a sample of over 2000 searches conducted by a professional population of research scientists. Our sample was considerably smaller, and did not contain uniform numbers of cases from quarter to quarter. However, Flynn does note that lower labor costs can make manual searching cheaper, which proved to be accurate since student search costs are considerably less than those calculated for a professional population.

Table 1

Cost EFfectiveness

Date	Manual Cost	Online Cost
Winter 85*		
Spring 85	$25.00	$139.60
Winter 86	$33.65	$875.03
Spring 86	$33.55	$315.32

*data unavailable

b. Precision and Recall

Precision can be defined as the ability of a retrieval system to reveal only information of interest to the user, or the withholding of non-relevant items. It varies inversely with recall, the ability of a retrieval system to uncover all relevant information stored in the database. Precision can be expressed as the ratio of the number of relevant references retrieved to all references retrieved, and recall as the ratio of the number of relevant references retrieved to the total number of relevant references in the database. These numbers are often multiplied by 100 to express them as percentages. Precision measures the efficiency with which the system achieves a particular recall ratio (Borgman, 1984).

Results from our study produced the following information concerning precision and recall:

Table 3
Comparison of Precision and Recall

Type of Search	Recall	Precision
Manual	51%	40%
Online	84%	20%

Table 4
Relevancy and Overlap

Quarter	Manual	Online	Duplicated
Wint 85*			
Spr 85	40	83	---
Wint 86	63	130	8
Spr 86	23	51	1

*Data unavailable

It is noted that higher recall occurred online, while higher precision occurred through manual searching. Citation overlap was minimal, and more relevant citations were found through online searching than by hand searching.

A 1984 project by Woolpy and Taylor using students from Earlham College reported that a higher number of relevant articles (at twice the time) was found through manual searching than by online searching. The researchers also discovered that precision was highest for manual, rather than online searches.

The results of our study corroborate these findings. We also show greater precision for manual than online searching by almost a 2:1 margin. However, our sample found more relevant items online than by hand. This fact may be a result of students easily being able to shape their search question online while under the supervision of a subject specialist librarian-coach, unlike the Earlham College student who had less time to search anad less librarian supervision.

In comparison to professional searchers, the Cal Poly figures for recall coincide more closely with the Earlham College figures.

Table 5
Recall Among Students

Students	Manual	Online
Cal Poly	51%	84%
Earlham College	10%	8%

Table 6

Recall Among Professionals

Professionals	Manual	Online
Lancaster (Virgo)	44%	58%
Virgo	57%	50%
Eichesen	43%	57%
Smith (Eichesen)	92%	87%

c. Citation Overlap

Citation overlap between the manual and online sources was not high (2.9%). The average student found 17 citations manually and 67 citations online (over four times as much). This finding supports the work of Bivens (1974) who noted that computer searching may yield a higher percentage of unrelated material which does not duplicate manual searching, and Gill (1974) who also noted that although machine searches can yield high numbers of references, these are less relevant than if found manually. The low percentage of citation overlap may also indicate that:

(1) Students did not systematically search both the

print and online sources when corresponding titles existed.

(2) Complexity of the search question may have influenced the access and retrievability of the information.

(3) A corresponding source may not have existed for a particular subject area (e.g. no print equivalent for an online file, and vice versa). Collection coverage was not equal.

(4) The number of search terms used in the print and online sources may not have been comparable.

(5) Experience levels in using print and online sources may have influenced search results, even though few individuals had experience searching online databases prior to taking the class.

(6) Time constraints may have influenced the amount of user effort expended.

d. Hours Searched

Cal Poly students engaged in more manual searching hours than did their Earlham College counterparts (probably due to greater print resources available in a university library than in a college setting). When compared to professional searchers, Cal Poly students conducted less manual searching. This pattern probably emerged since the students were granted free access to database searching in an unlimited number of files. Additionally, the students perceived the online search experience to be more cost effective for their time, a more current source for locating needed information, and of greater appeal for identifying desired information due to the opportunity to interact with computer-based technology.

Table 7

Study	Date	Manual Search Hours
Students		
Cal Poly	1985-86	5.5
Earlham College	1984	2.0
Professionals		
Elman	1974	22.0
Bivans	1974	20.0
Maier (Elman)	1974	22.0
Rogers (Elman)	1968	16.0

SUMMARY

This exploratory study examined five common characteristics of manual and online searching (cost effectiveness, precision, recall, citation overlap, and time) using a pool of Cal Poly undergraduate and graduate students as subjects.

Based upon the results of this preliminary investigation, it was found that (amongst students) self service computer searching was not found to be a cost effective method for retrieving data, that precision was highest for manual searching, that recall was highest for online searching, that citation overlap was under 3%, and that more time was spent by students searching manually, than online.

Although these first-time searching participants seemed to be motivated and satisfied with the results of their research, several areas have been identified as worthy of further exploration:

(1) The relationship between satisfaction and precision (high satisfaction does not mean high precision).

(2) The influence of multiple instructional strategies upon search output (do student searchers retrieve more relevant citations through classroom-based instruction, peer coaching, individualized instruction, a combination of strategies, or by some other methods?)

(3) The association between the number of relevant items found and the time expended (if computer searching yields a higher percentage of unrelated materials, what are the time and cost trade-offs?)

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